AUTOMATED JET MOMENTUM CALCULATION FROM DIGITAL DOPPLER FLOW MAPS

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We have previously shown that momentum (M, the product of flow rate and orifice velocity) is the best jet parameter for predicting jet appearance by Doppler flow mapping. We have also shown that quantifying M within the jet allows flow rate to be calculated, but this approach has been limited by the errors inherent in decoding velocity from analog video tape. We have now developed an algorithm which uses digital velocity data output directly from the polar Doppler map to calculate M. The user must specify the approximate orifice location and jet direction; a series of transverse velocity profiles are then extracted at 30 to 60 points along the jet axis. After angle correction to yield axial velocity v, jet momentum through each of these transverse planes is calculated assuming rotational symmetry of the jet:

$$M = \rho \int v^2 \, r \, dr,$$

where r is the distance from the jet axis and the integral includes the full transverse profile. These momentum calculations are averaged to yield a mean value for the jet as a whole. As an initial test of this algorithm, we imaged steady jets in an *in vitro* flow model. RESULTS: For 72 flow maps of jets with known momentum (x) ranging from 120 to 940 cm^4/s^2, the calculated momentum (y) agreed well: $y = 104.7 + 0.89x$, $r=0.95$, $p<0.0001$, S.D. reg=101.8. CONCLUSION: Jet momentum can be accurately measured from directly digitized Doppler flow maps. This may allow more accurate quantification of regurgitant flow rate in clinical Doppler practice.

A NEW AUTOMATIC COMPUTER METHOD FOR MEASURING MEAN FLOW CONVERGENCE RADIUS FROM COLOR MQ MODES PROVIDES MORE ACCURATE FLOW RATE ESTIMATES: IN-VITRO AND ANIMAL STUDIES OF MITRAL REGURGITATION.

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While flow convergence (FC) methods appear accurate for flow rate (FR) calculation in simple steady flow models, their use in physiological pulsatile conditions is hampered by temporal changes in flow acceleration sampled by slow frame rates of color Doppler. We studied FC quantitation of mitral regurgitation (MR) in-vitro using 2 modeled in-vitro MR orifices (a concave surface with a central orifice (OR) and a bi-concave surface with an OR in 1 depression "prolapse") and in-vivo in 10 instrumented sheep with chronic (n=5) or acute (n=5) MR. A custom-designed computerized edge tracking system determined mean systolic flow convergence radius as the distance from the blue to red alias to the valve trace on color M-mode waveforms obtained through the OR center and calculated mean flow rate automatically. The color M-modes showed organized and smoothly changing alias zones without the random errors seen on 2-D color scans and the distance from the alias to the orifice boundary was clearly delineated. Automatically tracking the MQ radii yielded better agreement between calculated and actual FR than measuring the 2-D radius for both in-vitro (MQ: r=0.90, SEE=92 cc/min, y=0.88x-18; 2-D: r=0.72, y= 0.4 x+768) and animal studies (M-Q: r=0.98, y=1.05x-302; 2-D: r=0.78, y=5.2 x +858). Greater sequential packet size makes the MQ mode more accurate for flow convergence calculations and the continous systematic traces render them more easily quantified. Our new computerized FC calculation method should aid in clinical application of FC methods.

ABNORMAL EARLY DIASTOLIC FILLING RESPONSE TO LEFT VENTRICULAR UNLOADING IN RENAL TRANSPLANT PATIENTS

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In this study, we hypothesized that the relation between early mitral flow changes and LV end-diastolic dimension (EDD) changes obtained by altering loading conditions might provide a method for detecting occult compliance abnormality. That is, a ventricle with reduced compliance might result in a abnormally large decrease in the mitral flow E wave peak velocity and deceleration for a small decrease in EDD. Accordingly, we evaluated 8 renal transplant patients (RT pts; age 47±11 years) with LV hypertrophy selected for normal peak velocity and normal deceleration of the E wave by comparison with 10 normal subjects (N; age 34±10 years). Doppler mitral flow and M-mode LV dimensions were measured at rest and after administration of 0.8 mg sublingual nitroglycerin (NTG). M-mode and Doppler echo measurements were averaged over 8 to 12 cardiac cycles before as well as after NTG. Results: (BP=systolic blood pressure in mmHg; HR= heart rate in beat/min; h= end-diastolic wall thickness) *p<0.05

Baseline	BP	HR	h(mm)	EDD(mm)	E(cm/s)	decel(cm/s/s)
N	127±13	68±9	9±1	49±5	72±13	525±163
Pts	142±21	71±13	13±1*	47±7	81±13	556±182

Percent changes after NTG (%)	BP	HR	EDD	E	decel
N	-14±6	+9.7±6	-8.0±2.3	-17±5	-43±11
RT	-15±10	+8.7±7	-7.9±1.1	-31±12*	-54±13*

Thus, for similar reduction in proportion in end-diastolic dimensions, RT patients respond with a higher decrease in the E wave peak velocity and deceleration when compared with normal subjects. These results may suggest occult restrictive physiology in renal transplant patients with LV hypertrophy. The relation between mitral flow and end-diastolic dimension variations induced by altered LV loading may provide a noninvasive method for detecting occult diastolic dysfunction.

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Poster Displayed: 9:00AM–12:00NOON
Author Present: 11:00AM–12:00NOON
Hall F, West Concourse
Therapies and Manifestations of Cardiac Disease in Older Persons

ACUTE HEART FAILURE IN THE ELDERLY: ANOTHER MANIFESTATION OF UNSTABLE "ANGINA".

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Although chronic congestive heart failure (CHF) is a well recognized syndrome in patients with coronary artery disease (CAD), acute CHF, unassociated with an acute myocardial infarction (MI), is infrequent and its mechanism poorly understood. In this study, the clinical course of 23 patients with CAD and acute CHF (symptoms ((Sx)) less than 24 hours) were evaluated. Twelve were females and 11 were males, mean age 69 (median 70, SD ± 9). No patient had an associated acute MI and only 25% had a past history of an MI. Twenty-two percent of patients were free of previous Sx of CHF. Ninety percent of patients had a past history of hypertension, and on admission, the average BP was 180 ± 42/114 ± 26. Although all patients survived the hospitalization, 38% required intubation with ventilatory assistance, and the mean hospital duration was 16 ± 5 days. All patients underwent cardiac catheterization: one (4%) patient had left main disease; 16 (70%) 3-vessel disease (VD); 3 (13%) 2-VD; and 4 (17%) 1-VD. The mean left ventricular ejection fraction was 43 ± 12%. Fifteen (65%) patients required invasive therapeutic intervention with 48% undergoing coronary artery bypass surgery (CABG) and 17% having coronary artery angioplasty (PTCA). At a mean follow-up of 23 ± 18 months 73% of patients are alive.

CONCLUSION:

Acute CHF in patients with CAD is most commonly seen in elderly, hypertensive females. These patients usually have extensive CAD but good left ventricular systolic function. Prognosis appears to be good although a majority of patients required CABG or PTCA.